9. (New) The semiconductor device according to claim 1, wherein said work function of the tantalum nitride films is 5.41eV.

10. (New) The semiconductor device according to claim 2, wherein said work function of the tantalum nitride films is up to 5.41eV.

cont'd C2

11. (New) The semiconductor device according to claim 2, wherein said work function of the tantalum nitride films is equal to or greater than 5.41eV.

12. (New) The semiconductor device according to claim 2, wherein said work function of the tantalum nitride films is 5.41eV.--

REMARKS

At the time of the Office Action dated July 18, 2002, claims 1-6 were pending in this application. Of those claims, claims 1-3 have been rejected. Applicants acknowledge, with appreciation, the Examiner's indication that claims 4-6 contain allowable subject matter.

Claims 1 and 2 have been amended, and claims 7-12 have been added. Care has been exercised to avoid the introduction of new matter. Specifically, claims 1 and 2 have been amended to clarify that the tantalum nitride films each have a work function greater than 4.95eV. These limitations find adequate descriptive support throughout the originally filed disclosure, for

example, on page 11, lines 5-14. The limitations of claims 7-12 also find support in the same passage in page 11.

Claims 1 and 2 are rejected under 35 U.S.C. § 102 for lack of novelty as evidenced by Choi et al., U.S. Patent No. 6,168,991 (hereinafter Choi)

On pages three and four of the Office Action, the Examiner concluded that Choi identically discloses a semiconductor device according to claims 1 and 2. This rejection is respectfully traversed.

Initially, Applicants note that claims 1 and 2 have both been amended to recite that the tantalum nitride films that make up the electrodes of the capacitor have a work function greater than 4.95eV. As discussed in the first full paragraph on page 11 of the specification, by having a work function greater than 4.95eV, the introduction of electrons into a tantalum oxide film as a capacitor dielectric is restricted, and thus, the generation of leakage current in the capacitor dielectric is suppressed.

A review of Choi, particular of column 4, lines 36-46, fails to yield that Choi teaches that the work function of the tantalum nitride electrode layer 20 is greater than 4.95eV. As such, Choi fails to identically describe the claimed invention within the meaning of 35 U.S.C. § 102. Thus, Applicants respectfully solicit the withdrawal of the imposed rejection of claims 1 and 2 under 35 U.S.C. § 102 for lack of novelty as evidenced by Choi.

Claim 1 is rejected under 35 U.S.C. § 103 for obviousness predicated upon Alers, et al., U.S. Patent No. 6,265,260 B1 (hereinafter Alers), in view of a publication to Drynan, et al. (hereinafter Drynan)

On pages five and six of the Office Action, the Examiner concluded that the combined disclosures of Alers and Drynan discloses the invention as claimed. This rejection is respectfully traversed.

As previously discussed, claims 1 and 2 have both been amended to recite that the tantalum nitride films that make up the electrodes of the capacitor have a work function greater than 4.95eV. However, neither Alers nor Drynan discloses or suggests this particular limitation. As such, even if Alers and Drynan were combined in the manner suggested by the Examiner, the claimed invention would not result.

Applicants also incorporate herein the arguments previously presented in the Appeal Brief filed June 6, 2002, regarding this rejection. Applicants would also note that the Examiner has failed to address in the present Office Action the substance of the nearly six pages of arguments that Applicants submitted in the Appeal Brief. See M.P.E.P. § 707.07(f). For example, the Examiner has not addressed the teaching away of the claimed invention by Drynan or addressed the indicia of nonobviousness asserted by Applicants.

In addition to the arguments incorporated herein, Applicants would emphasize a point regarding the Examiner's asserted motivation to combine (i.e., "to include a tungsten film for low resistance"). Specifically, many other materials, such as copper, aluminum, etc., have been

advocated by the prior art for use as plug material. These materials are also known to have "low resistance." As such, why would one having ordinary skill in the art select tungsten over these other materials? It certainly cannot be solely based on the Examiner's assertion that tungsten provides "low resistance," because many materials, such as copper, have a lower resistance than tungsten.

Put a different way, the Examiner's logic regarding the motivation element is similar to arguing that it would have been obvious to select a particular material (for example, silicon nitride) for a dielectric layer of a capacitor because that particular material has a high dielectric constant, and materials with high dielectric constants are desired for dielectric layers in a capacitor. Using such reasoning, the use of any material with a high dielectric constant as a dielectric layer in a capacitor would be obvious. This logic, however, neglects to consider whether the invention as a whole would have been obvious, and thus, whether the combination of materials recited for a well-known structure (such as a capacitor) would have been obvious. Thus, Applicants respectfully submit that the Examiner has failed to supply the requisite realistic motivation to modify Alers in view of Drynan.

It should, therefore, be apparent that the Examiner has not discharged the initial burden of establishing a prima facie case of obviousness under 35 U.S.C. § 103. Applicants, therefore, respectfully submit that the imposed rejection of claim 1 under 35 U.S.C. § 103 for obviousness predicated upon Alers in view of Drynan is not factually or legally viable and, hence, solicit withdrawal thereof.

Claim 3 is rejected under 35 U.S.C. § 103 for obviousness predicated upon Kang, U.S. Patent No. 6,211,005, in view of Drynan

On pages six through eight of the Office Action, the Examiner has again taken a reference (i.e., Kang) with a broad disclosure as to various materials that can be used for the electrodes and dielectric of a capacitor and combined this broad disclosure with the teachings of Drynan. This rejection is respectfully traversed.

Initially, Applicants note that as part of a prima facie analysis of obviousness, the Examiner is to construe each term in the claim consistent with the specification. **See** 37 C.F.R. § 1.56(b)(2)(ii). This allows Applicants fair opportunity to evaluate the teachings of the applied prior, as compared to the claimed invention. As discussed in M.P.E.P. § 706.02(j), "[it] is important for an examiner to properly communicate the basis for a rejection so that the issues can be identified early and the applicant can be given fair opportunity to reply." The Examiner, however, has apparently failed to construe the meaning of the term tantalum oxide (Ta_2O_5) consistent with the specification. As discussed on page 1, lines 22 and 23 of Applicants' specification tantalum oxide is expressed with the chemical formula Ta_2O_5. In the statement of the rejection, the Examiner asserted that $SrBi_2Ta_2O_9$ discloses the claimed tantalum oxide film of claim 3. However, the Examiner has provided no factual basis of record that indicates that one having ordinary skill in the art would have considered the disclosure of $SrBi_2Ta_2O_9$ to be a disclosure of tantalum oxide, as that term is used consistent with Applicants' specification. As such, there is no factual basis upon which to support even a prima facie case of obviousness under 35 U.S.C. § 103. **In re Freed**, 425 F.2d 785, 165 USPQ 570 (CCPA 1970).

Furthermore, in column 6, lines 33-34, Kang states that the dielectric is formed from a Perovskite structure. A Perovskite structure has ABX_3 stoichiometry and is composed of a three-dimensional framework of corner sharing BX_6 octahedra. The A-site cation fills the twelve coordinate cavities formed by the BX_3 network and is surrounded by twelve equidistant anions. There is no indication by the applied prior art, however, that Ta_2O_5 is a Perovskite structure. As such, one having ordinary skill in the art would not have been motivated to modify the dielectric film 56 of Kang to use a tantalum oxide film (Ta_2O_5).

The Examiner has also impermissibly engaged in hindsight reconstruction of the claimed invention in view of the teachings of Kang and Drynan. Kang teaches that many different materials can be used for the upper and lower electrodes 58, 54, such as: "Pt, Ru, Ir, Pd, IrO_2, a platinum oxide, an osmium oxide, an indium oxide, an Indium Tin Oxide (ITO) and RuO_2" (column 6, lines 28-31). Kang also teaches that the material of the dielectric film 56 is selected from a material having a Perovskite structure. The Examiner then somehow picked and chose from this broad disclosure to arrive at the claimed combination of a storage electrode including a first indium oxide film, a capacitor dielectric film including a tantalum oxide film, and a cell plate electrode including a second indium oxide film. The Examiner, however, has failed to provide a reason <u>why</u> one having ordinary skill in the art would have selected the combination recited in claim 3 from the multitude of possible combinations disclosed by Kang.

As to the Examiner's citation of Drynan for the tungsten plug, Applicants incorporate herein the arguments previously presented with regard to the rejection of claim 1 for obviousness predicated upon Alers in view of Drynan. Applicants do not deny that tungsten can be used as a

contact plug in semiconductor devices. However, several other materials can also be used as a contact plug in semiconductor devices, and these other materials also provide well known advantages. It is not enough for the Examiner to provide a general reason to use tungsten plugs because in so doing, the Examiner fails to consider the claimed invention as a whole. Instead, the Examiner is to provide a reason why one having ordinary skill in the art would form a tungsten plug that contacts the capacitor recited in claim 3. This, however, has not been accomplished.

For the reasons stated above, Applicants, therefore, respectfully submit that the imposed rejection of claim 3 under 35 U.S.C. § 103 for obviousness predicated upon Kang in view of Drynan is not factually or legally viable and, hence, solicit withdrawal thereof.

Attached hereto is a marked-up version of the changes made to the claims by the current amendment. The attached page is captioned "Version with markings to show changes made."

Applicants have made every effort to present claims which distinguish over the prior art, and it is believed that all claims are in condition for allowance. However, Applicants invite the Examiner to call the undersigned if it is believed that a telephonic interview would expedite the prosecution of the application to an allowance. Accordingly, and in view of the foregoing remarks, Applicants hereby respectfully request reconsideration and prompt allowance of the pending claims.

To the extent necessary, a petition for an extension of time under 37 C.F.R. § 1.136 is hereby made. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account 500417, and please credit any excess fees to such deposit account.

Respectfully submitted,

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Version with markings to show changes made

IN THE CLAIMS:

1. (Amended) A semiconductor device, comprising:

a contact plug including a tungsten film in an upper portion of the contact plug, formed on a semiconductor substrate;

a storage electrode including a tantalum nitride film formed on and contacting an upper surface of said tungsten film;

a capacitor dielectric film including a tantalum oxide film formed on and contacting an upper surface of said tantalum nitride film; and

a cell plate electrode including a tantalum nitride film formed on and contacting an upper surface of said tantalum oxide film, wherein the tantalum nitride films of said storage electrode and said cell plate electrode each have a work function greater than 4.95eV.

2. (Three Times Amended) A semiconductor device, comprising:

a storage electrode including a first tantalum nitride film formed over a semiconductor substrate;

a capacitor dielectric film including a tantalum oxide film formed on and contacting an upper surface of said first tantalum nitride film; and

a cell plate electrode including a second tantalum nitride film formed on and contacting an upper surface of said tantalum oxide film and a copper film formed on and contacting an upper surface of said second tantalum nitride film, wherein said first and second tantalum nitride films each have a work function greater than 4.95eV.

Please add the following:

--7. (New) The semiconductor device according to claim 1, wherein said work function of the tantalum nitride films is up to 5.41eV.

8. (New) The semiconductor device according to claim 1, wherein said work function of the tantalum nitride films is equal to or greater than 5.41eV.

9. (New) The semiconductor device according to claim 1, wherein said work function of the tantalum nitride films is 5.41eV.

10. (New) The semiconductor device according to claim 2, wherein said work function of the tantalum nitride films is up to 5.41eV.

11. (New) The semiconductor device according to claim 2, wherein said work function of the tantalum nitride films is equal to or greater than 5.41eV.

12. (New) The semiconductor device according to claim 2, wherein said work function of the tantalum nitride films is 5.41eV.--